

WHAT IS CLAIMED IS:

1. A method for inspecting an exposure apparatus, comprising:

5 a step of guiding light emitted from an illumination optical system to a photomask where a pattern is formed of an optical member including a light transmission pattern as a diffraction grating pattern, in which a light transmission part and a opaque part are repeated in a predetermined direction, 10 a plurality of ratios are given between a length of the light transmission part and a length of the opaque part in a repetition direction, and a periphery of the light transmission pattern is shielded by a opaque area, such that a plurality of ratios are given between the light 15 transmission part and the opaque part;

20 a step of irradiating diffraction light, which has passed through the photomask, on a projection optical system, thereby to transfer a pattern reflecting an intensity distribution of the diffraction light to a wafer; and

25 a step of measuring a change of transmittance depending on a light path of the projection optical system, based on a pattern image of the diffraction light transferred to the wafer.

2. A method according to claim 1, wherein said pattern transfer is performed in which the photomask and the wafer are non-conjugate with respect to the

projection optical system.

3. A method according to claim 1, wherein, where
NA is a numerical aperture of the projection optical
system in a side of the wafer, λ is a exposure length,
5 σ is a coherence factor, and M is a magnification of
the photomask, the diffraction grating pattern has
a period which satisfies

$$p > M\lambda / NA(1 + \sigma)$$

4. A method according to claim 1, wherein the
10 non-conjugate state in which the photomask and the
wafer are non-conjugate with respect to the projection
optical system is realized by arranging the opaque part
of the light optical member on a surface opposite to
a surface where the optical member of the photomask
used for device pattern exposure is arranged.

5. A method according to claim 1, wherein, where
a length of a longest line among lengths of lines
connecting arbitrary two points positioned on a
boundary to the opaque part, of the opaque part of
20 the light transmission pattern, is $2r$, a thickness of
the photomask is d , an exposure wavelength is λ , and
a refractive index of a material of the photomask at
the exposure wavelength λ is n , a relationship of
 $0.4(nd\lambda)^{1/2} \leq r \leq (nd\lambda)^{1/2}$ is satisfied.

25 6. A method according to claim 5, wherein the
light transmission pattern is a circular pattern having
a radius r .

7. A method according to claim 6, wherein where, of the light pattern, an area surrounded by the opaque area is expressed πr^2 , a thickness of the photomask is d , an exposure wavelength is λ , and a material of the photomask has a refractive index of n , a relationship of $0.4(nd\lambda)^{1/2} \leq r \leq 10(nd\lambda)^{1/2}$ is satisfied.

8. A method according to claim 1, wherein the pattern formed on the wafer is made of a predetermined material, and

10 the change of the transmittance is measured by measuring a film thickness of the pattern transferred to the wafer and by obtaining a light intensity of the diffraction light, based on a predetermined relationship between a film thickness of the predetermined material and an irradiation light intensity.

15 9. A method according to claim 1, wherein the predetermined relationship between the film thickness of the predetermined material and the light intensity is a sensitivity curve expressing the relationship between the film thickness of the predetermined material and the light intensity.

20 10. A method according to claim 1, wherein a change of the transmittance is measured in a manner that a boundary between an area where photoresist was stripped and an area where photoresist was remained is regarded as a equal-intensity contour curve, a plurality of equal-intensity contour curves each being

the equal-intensity contour curve are obtained respectively under different conditions, and the plurality of equal-intensity contour curves obtained are layered thereby to obtain an equal-intensity contour plot.

5 11. A method for inspecting an exposure device, comprising:

a step of guiding light emitted from an illumination optical system to a photomask where
10 a pattern is formed of an optical member including a light transmission pattern as a diffraction grating pattern, in which a light transmission part and a opaque part are repeated in a predetermined direction, a plurality of ratios are given between a length of the
15 light transmission part and a length of the opaque part in a repetition direction, phases of lights which pass through adjacent light transmission parts with the opaque part inserted therebetween differs from each other substantially by 180° , and a periphery of the
20 light transmission pattern is shielded by a opaque area, such that a plurality of ratios are given between the light transmission part and the opaque part;

25 a step of irradiating diffraction light, which has passed through the photomask, onto a projection optical system, thereby to transfer the pattern to a wafer and to form a pattern reflecting an intensity distribution of the diffraction light; and

a step of measuring a change of transmittance depending on a light path of the projection optical system, based on a pattern image of the diffraction light transferred to the wafer.

5 12. A method according to claim 11, wherein said pattern transfer is performed in which the photomask and the wafer are non-conjugate with respect to the projection optical system.

10 13. A method according to claim 11, wherein the pattern formed on the wafer is made of a predetermined material, and

15 the change of the transmittance is measured by measuring a film thickness of the pattern transferred to the wafer and by obtaining a light intensity of the diffraction light, based on a predetermined relationship between a film thickness of the predetermined material and an irradiation light intensity.

20 14. A method according to claim 11, wherein the predetermined relationship between the film thickness of the predetermined material and the light intensity is a sensitivity curve expressing the relationship between the film thickness of the predetermined material and the light intensity.

25 15. A method according to claim 11, wherein a change of the transmittance is measured in a manner that a boundary between an area where photoresist was stripped and an area where photoresist was remained

is regarded as a equal-intensity contour curve,
a plurality of equal-intensity contour curves each
being the equal-intensity contour curve are obtained
respectively under different conditions, and the
5 plurality of equal-intensity contour curves obtained
are layered thereby to obtain an equal-intensity
contour plot.

16. A method for inspecting an exposure device,
comprising:

10 a step of guiding light emitted from an
illumination optical system to a photomask where
a pattern is formed of an optical member including
a light transmission pattern as a diffraction grating
pattern, in which a first light transmission part and
15 a second light transmission part having a lower
transmittance than the first light transmission part
are repeated in a predetermined direction, a plurality
of ratios are given between lengths of the first and
second light transmission parts in a repetition
direction, phases of lights which pass through the
20 first and second light transmission parts adjacent to
each other differ from each other, and a periphery of
the light transmission pattern is shielded by a opaque
area, such that a plurality of ratios are given between
25 the light transmission part and the opaque part;

a step of irradiating diffraction light, which has
passed through the photomask, onto a projection optical

system, thereby to transfer the pattern to a wafer and to form a pattern reflecting an intensity distribution of the diffraction light; and

5 a step of measuring a change of transmittance depending on a light path of the projection optical system, based on a pattern image of the diffraction light transferred to the wafer.

10 17. A method according to claim 16, wherein said pattern transfer is performed in which the photomask and the wafer are non-conjugate with respect to the projection optical system.

15 18. A method according to claim 16, wherein the pattern formed on the wafer is made of a predetermined material, and

20 19. A method according to claim 16, wherein the predetermined relationship between the film thickness of the predetermined material and the light intensity is a sensitivity curve expressing the relationship between the film thickness of the predetermined material and the light intensity.

25 20. A method according to claim 16, wherein

a change of the transmittance is measured in a manner
that a boundary between an area where photoresist was
stripped and an area where photoresist was remained
is regarded as a equal-intensity contour curve,
5 a plurality of equal-intensity contour curves each
being the equal-intensity contour curve are obtained
respectively under different conditions, and the
plurality of equal-intensity contour curves obtained
are layered thereby to obtain an equal-intensity
10 contour plot.